Open Journal of Marine Science, 2025, 15(1), 13-34
https://www.scirp.org/journal/ojms
ISSN Online: 2161-7392
ISSN Print: 2161-7384

Exploration of the Seaweed Resources in Nigeria: A Case Study of Lagos Coastal Waters

Esther U. Kadiene[1,2*], Daniel Oluwaleke Biaoku[3], Dunsin Abimbola Bolaji[3], Simon Ekele[4], Edike Kaine Adewunmi[4], Adeyemi Oluwatobi[5], Olaolu Akerele[6]

[1]Department of Animal and Environmental Biology, Faculty of Science, Delta State University, Abraka, Nigeria
[2]Centre for Research and International Programmes, Delta State University, Abraka, Nigeria
[3]Nigerian Institute for Oceanography and Marine Research, Victoria Island, Lagos, Nigeria
[4]AquaEarth Consulting, Victoria Island, Lagos, Nigeria
[5]Adeyemi Golden Hatch Farm, Abeokuta, Nigeria
[6]African Seaweed Ventures Ltd, London, United Kingdom
Email: *estherkadiene@gmail.com, *ekadiene@delsu.edu.ng

How to cite this paper: Kadiene, E.U., Biaoku, D.O., Bolaji, D.A., Ekele, S., Adewunmi, E.K., Oluwatobi, A. and Akerele, O. (2025) Exploration of the Seaweed Resources in Nigeria: A Case Study of Lagos Coastal Waters. *Open Journal of Marine Science*, **15**, 13-34.
https://doi.org/10.4236/ojms.2025.151002

Received: November 8, 2024
Accepted: December 15, 2024
Published: December 18, 2024

Abstract

This study provides an in-depth exploration of seaweed biodiversity in Nigeria's coastal waters, a largely unexplored area for marine resources. There is a dearth of sufficient data on seaweed biodiversity in Nigeria. The research aimed to assess the diversity and distribution of seaweeds in this region. Seaweed samples were collected by hand, using scrapers, at low tide from four stations identified by local fisherfolk and commercial divers. These samples were analyzed in the laboratory for species identification. A total of 39 seaweed taxa were identified, with Rhodophyta (red algae) being the most abundant (74%), followed by Chlorophyta (green algae) (21%) and Heterokontophyta (brown algae) (5%). The highest biomass species included *Grateloupia sp.*, *Chaetomorpha antennina*, *Gracilaria sp.*, *Ceratodictyon variabile*, *Cladophora sp.*, *Gelidium pusillum*, *Ulva sp.*, *Blidingia minima*, *and Caloglossa leprieurii.* Species abundance was highest on breakwater rocks and on the bodies of anchored or sunken vessels, while sandy beaches exhibited lower abundance. The findings reveal significant potential for Nigeria's seaweed in aquaculture, climate change mitigation, and biotechnology. The study recommends further molecular research, expansion of sampling areas, and the development of sustainable seaweed cultivation practices to support Nigeria's blue economy.

Keywords

Seaweed Biodiversity, Lagos Coastal Waters, Marine Ecology, Macroalgae, Blue Economy, Aquaculture

1. Introduction

Marine coastal environments are incredibly diverse, each characterized by unique ecological features that influence their biodiversity. Coastal ecosystems are vital for maintaining marine biodiversity, providing critical habitats for various species [1]. Seaweeds are multicellular marine macroalgae essential to global coastal ecosystems. There are about 10,000 species of macroalgae. They are classified into the phyla: Chlorophyta (green algae), Heterokontophyta (brown algae) and Rhodophyta (red algae) based on their pigmentation [2] [3]. They play a significant role in marine ecological balance by contributing to primary production, nutrient cycling, and serving as both habitat and food for numerous marine organisms. Additionally, they offer substantial ecological benefits, such as bioremediation [4] [5], carbon sequestration [6]-[8], and protection against eutrophication [9] [10]. Seaweeds also act as bioindicators, providing valuable insights into the health of marine environments [11]. Beyond their ecological importance, seaweeds are well-known for their high nutritional value, being rich in vitamins, minerals, proteins, and polysaccharides [12] [13]. They are increasingly recognized for their economic potential, supporting various industries such as food, pharmaceuticals, biotechnology, aquaculture, cosmetics, and bioplastics. In many parts of the world, seaweeds are cultivated for the production of hydrocolloids like agar, alginates, and carrageenan which have numerous industrial applications [14] [15].

Lagos State, Nigeria's largest urban center and economic hub, plays a key role in the country's economy. With its strategic location along the Gulf of Guinea, Lagos serves as a major gateway for international trade, hosting some of the busiest ports in West Africa [16]. The city's commercial activities, including shipping, oil and gas, and fishing, contribute significantly to Nigeria's GDP [17]. However, rapid urban expansion has led to extensive land reclamation and sand-filling projects aimed at creating more space for development. These activities, while economically beneficial, have drastically altered the natural coastal ecosystem. Increased sedimentation from these projects has impacted the hydrology of Lagos's coastal waters, resulting in the loss of critical habitats and placing immense pressure on biodiversity [18]. Despite these challenges, Lagos's coastal waters still exhibit significant potential for seaweed biodiversity, although this resource remains underexplored. Understanding and documenting seaweed biodiversity is crucial for both ecological conservation and the development of sustainable economic practices, such as seaweed cultivation. The exploration of Nigeria's seaweed biodiversity offers an opportunity to inform conservation efforts while contributing to the country's blue economy.

This study is one of the first explorations of seaweed diversity in Nigeria, with a particular focus on Lagos's coastal waters. We documented the species present, their distribution, and their potential applications. This research contributes to the growing body of knowledge on Nigeria's marine biodiversity and lays a foundation for future studies and sustainable management practices. As global attention shifts toward sustainable marine resources, Nigeria stands to benefit from the exploration and sustainable utilization of its seaweed biodiversity. This study aims to address the knowledge gap by documenting the seaweed species in Lagos coastal waters.

2. Materials and Methods

2.1. Description of the Study Area

Nigeria is located on the west coast of Africa, bordered by the Atlantic Ocean to the south, with a coastline stretching over 853 kilometers. The country's Exclusive Economic Zone (EEZ) extends 200 nautical miles offshore, encompassing a significant portion of the Gulf of Guinea, known for its rich biodiversity and productive marine ecosystems. The Nigerian marine environment is characterized by warm tropical waters with temperatures ranging from 25˚C to 30˚C throughout the year, and salinity levels typically between salinity 30 and 35. The Nigerian coastline features diverse marine habitats, including sandy beaches, mangrove swamps, estuaries, and lagoons, which support a wide array of marine life. The intertidal action in Nigeria is influenced by semi-diurnal tides, with two high and two low tides occurring within a 24-hour period. The Lagos coastal waters are influenced by both oceanic and estuarine processes. The area is characterized by a network of lagoons, creeks, and estuaries, including the Lagos Lagoon, which connects to the Atlantic Ocean through the Lagos Harbor.

2.2. Sampling Stations

The study was a blind exploration, since no work had been done before now to indicate the locations of seaweed community, aside from sighting of Sargassum floating in water or washed up on the beach. Several locations were explored using information provided by fisher folks during their fishing expeditions and from commercial divers who clean fouled vessels. Due to high cost, the exploration was limited to the locations below where seaweeds were found (**Figure 1**):

1) Station 1: Jegeme Beach (6˚23'49.74468"N, 3˚0'18.96984"E), a sandy beach.

2) Station 2: Ibeshe Beach (6˚24'16.56"N, 3˚ 15'16.1316"E), a sandy beach.

3) Station 3: Anchorage (6˚22'44.0988"N, 3˚ 23'7.3404"E), located about one nautical miles within Lagos coastal waters where vessels from and to international waters anchor temporarily for repairs, inspection, when detained or arrested or for other reasons. This station provides a unique habitat for seaweeds, as the body vessels inside water serve as artificial reefs that support a variety of marine life. 6.39306, 3.39829.

4) Station 4: Lighthouse Beach/West Mole (6˚23'35.02"N, 3˚23'53.84"E**),** has an intertidal riprap breakwater. This site experiences strong wave action, which influences the type of seaweed species that can thrive in this high-energy environment. The Lighthouse Beach is divided by West mole from the Tarqua bay which is a sheltered bay with a mix of sandy and rocky substrates (man-made). The bay is also impacted by human activities, including tourism and shipping.

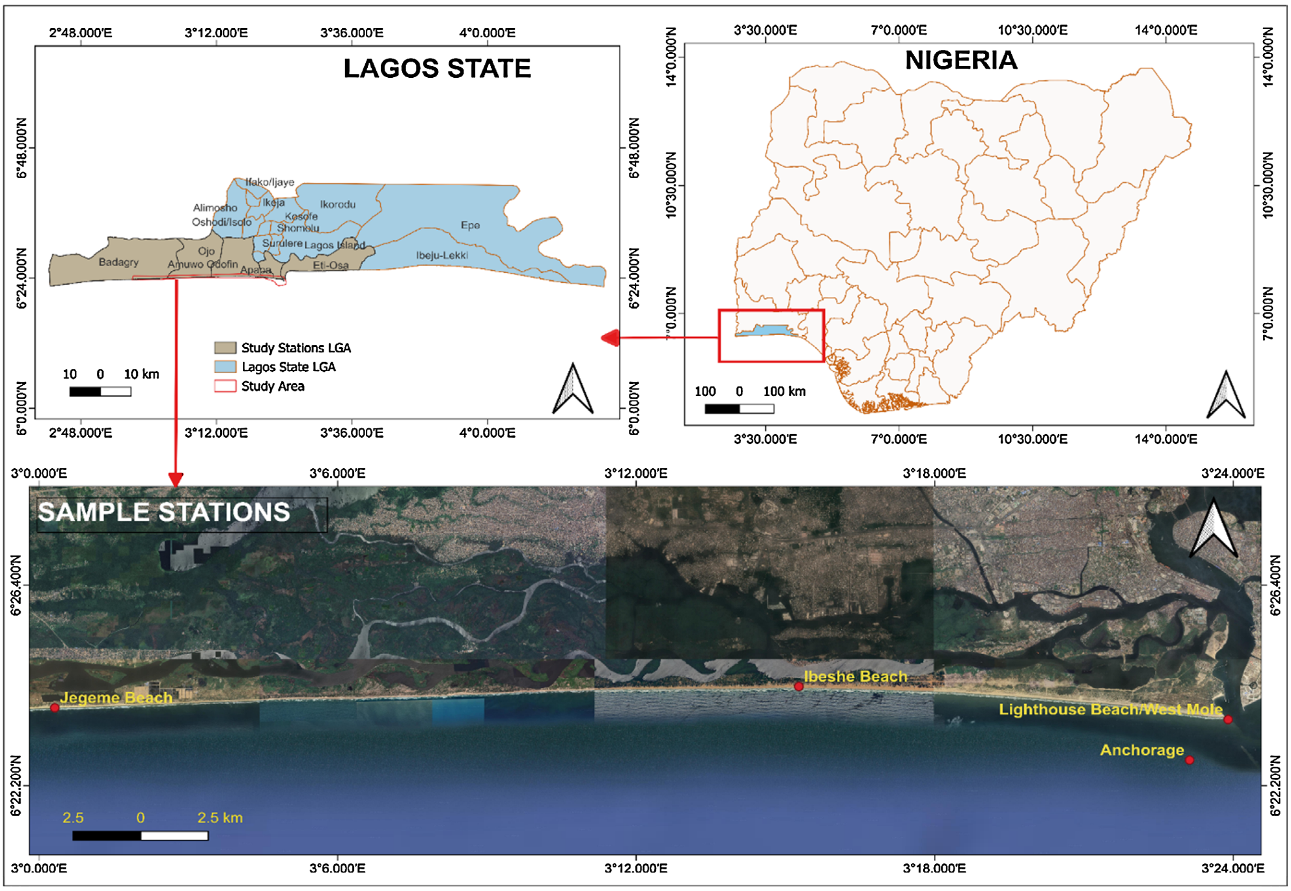

Figure 1. Satellite view of sampled stations along Lagos State coastline, Nigeria.

2.3. Sample Collection and Physicochemical Parameters of Sample Stations

The samples were collected randomly from the locations where they were found, enough to ensure a representative collection of seaweeds across different stations. Sampling was conducted during low tide by hand with the aid of a scraper from rocks, ropes and other material trapped between rocks and vessel hulls, seaweeds were picked from the beach, and those floating in the water were also collected. Samples were carefully placed in seawater-filled containers and Ziploc bags to preserve their natural state and transported to the laboratory for analysis. All observable information was collected in the field, with reference to their location, substrate and general description of the habitat, degree of exposure to wave action and light, associated plants or animals, etc.

The physicochemical properties of the seawater were analyzed *in situ* using a Multi-Parameter tester (pH, electric conductivity, TDS, and salinity). After collection, the seaweed biomass was cleaned by repeated washing to remove solid impurities, epiphytic plants and animals attached to them. The clean biomass was photographed.

2.4. Identification of Seaweed

Identification of the seaweed was done by visually observing their morphological features, and with the aid of a magnifying glass or microscope. The identification was based on the following criteria: color, nature, shape and size of the thallus, branching pattern, and type of holdfast. The sampled seaweeds were compared with images of seaweeds reported in several literature and from several databases, including Algae Base (https://www.algaebase.org/), World Register Marine Species, and Anderson *et al.* [19] (http://southafrseaweeds.uct.ac.za/).

3. Results

3.1. Seaweed Distribution

Seaweeds were found attached to riprap breakwater rocks and jetty structures, bodies of long-standing or sunken vessels, materials like rope or nylon sheets trapped between rocks (Figure 2A, Figure 3 and Figure 4), and Sargassum was found floating in the water or washed up on the beach.

3.2. Physicochemical Parameters

The physicochemical parameters measured at the sampling sites indicated that

Figure 2. Coast types and sampled stations. A. Satellite view of lighthouse beach/West mole (red arrow and circle indicates where seaweeds were found); B. Ibeshe and Jegeme community sandy beach; C. Intertidal riprap breakwaters where seaweeds were found.

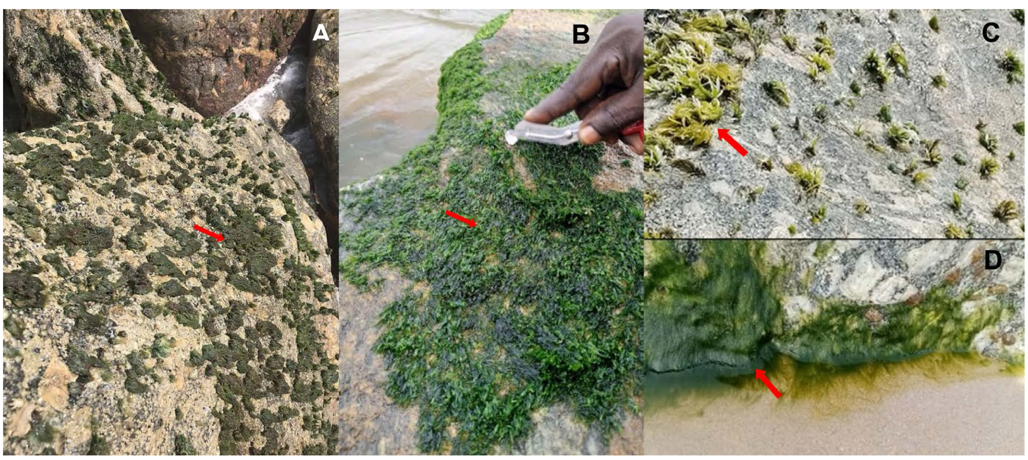

Figure 3. Monospecific vegetations of seaweeds on intertidal riprap breakwaters (red arrows). A. Monospecific vegetation of *Chaetomorpha antennina*; B. Monospecific vegetation of *Blidingia minima*; C. Monospecific vegetation of *Grateloupia sp.*; D. Monospecific vegetation of *Cladophora sp.*

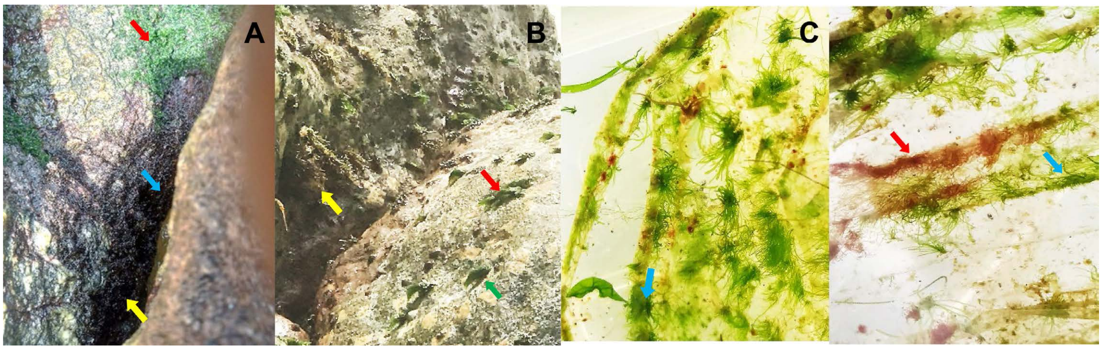

Figure 4. A. Multispecific vegetations of *Blidingia minima* (red arrow), *Caloglossa leprieurii* (yellow arrow) and an unspecified red macroalgae (blue arrow) attached to intertidal riprap breakwater rocks; B. Multispecific vegetations of *Grateloupia sp.* (red arrow), *Chaetomorpha antennina* (green arrow) and *Ceratodictyon variabile* (yellow arrow) attached to intertidal riprap breakwater rocks and C. multispecific vegetations of *Ulva* sp. (blue arrow) and some unspecified red macroalgae (red arrow) attached to nylon sheets stuck between riprap breakwater rocks.

the waters were suitable for seaweed growth, with pH levels ranging from 7.27 to 8.74, between 30 to 32.8 salinity, TDS ranged from 23.8 to 26.6, electric conductivity ranged from 47.6 to 52.4 and temperatures averaging 28.5˚C across the four stations (**Table 1**).

Table 1. Physicochemical parameters were measured *in situ* at the four stations.

Parameters	Station 1	Station 2	Station 3	Station 4
pH	7.51	7.27	8.74	7.59
Temperature (˚C)	28.9	28.8	29	29.2
Salinity (ppt)	32.7	32.8	30	32
TDS (mg/L)	26.5	26.4	23.8	26.6
Electric conductivity (mS/cm)	49.9	52.4	47.6	51.5

3.3. Seaweed Identification

Thirty-nine (39) taxa of seaweeds belonging to 19 genera and 17 families were identified (**Figure 5**), and summarized in **Table 2**.

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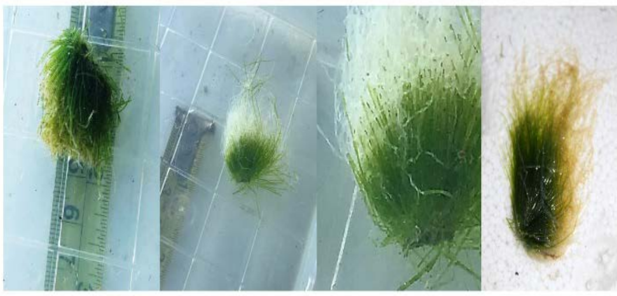

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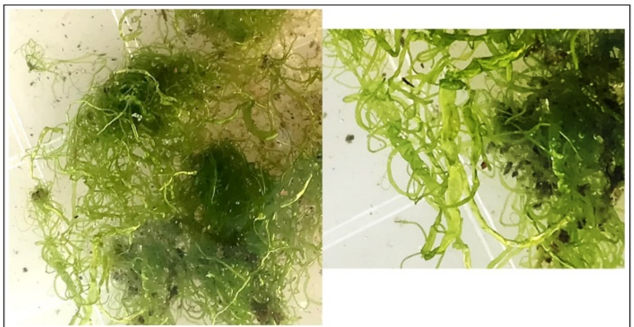

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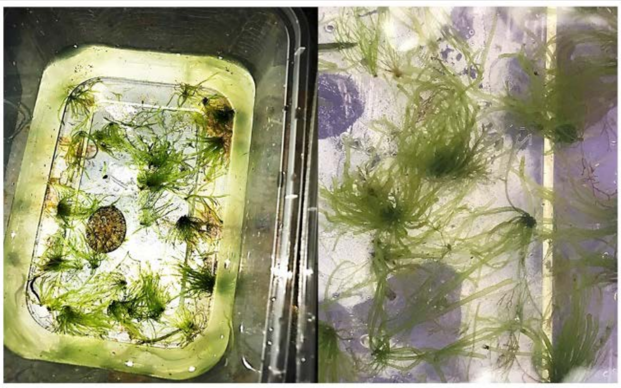

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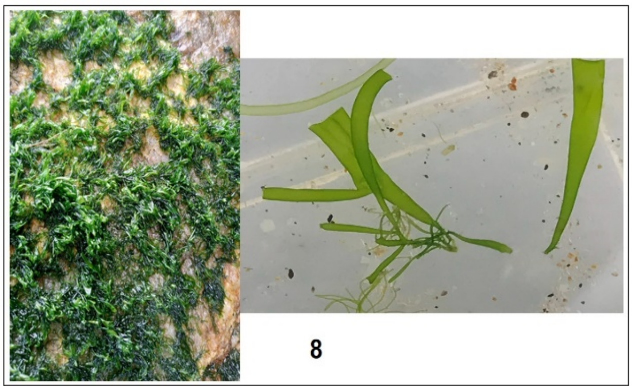

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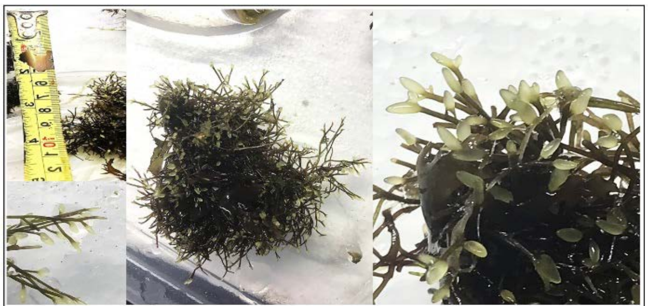

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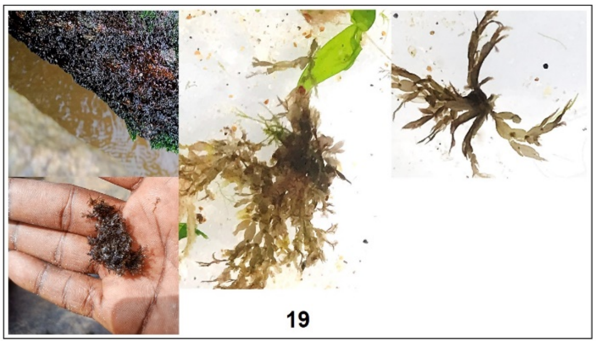

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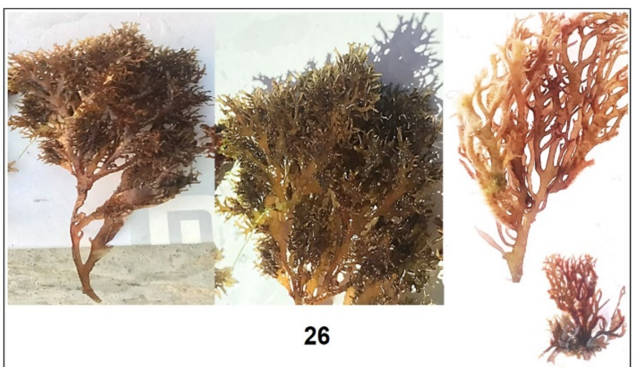

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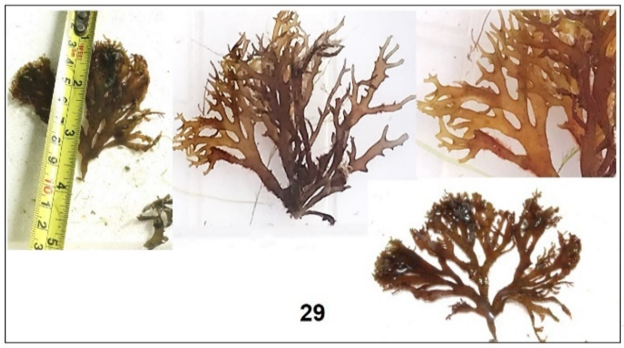

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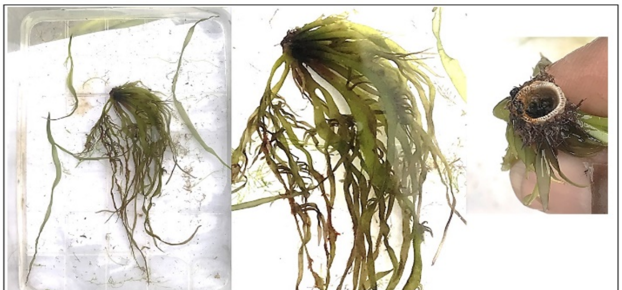

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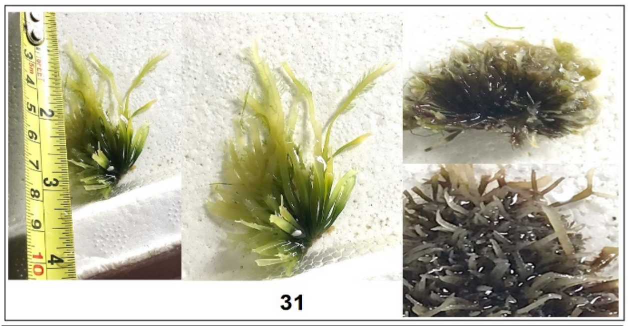

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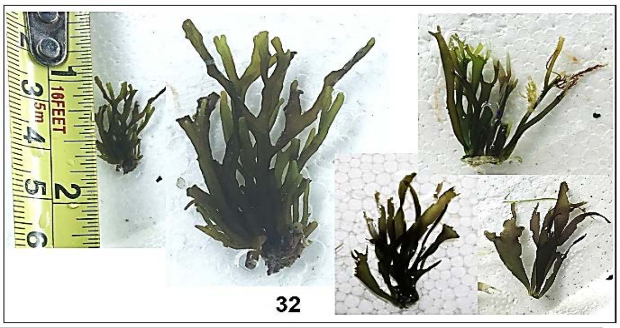

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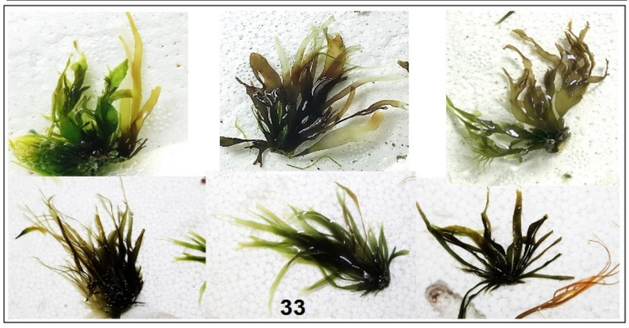

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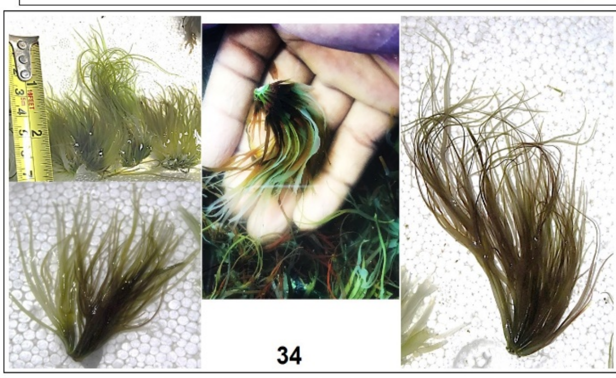

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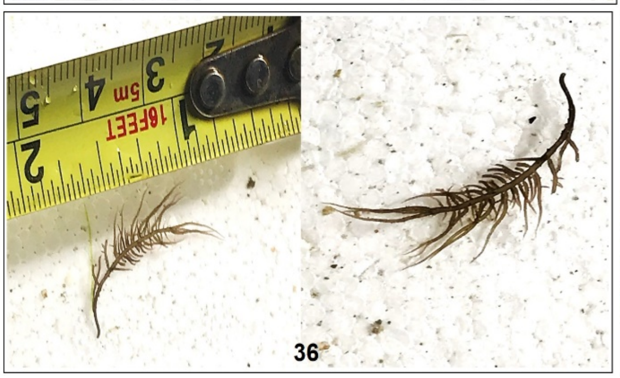

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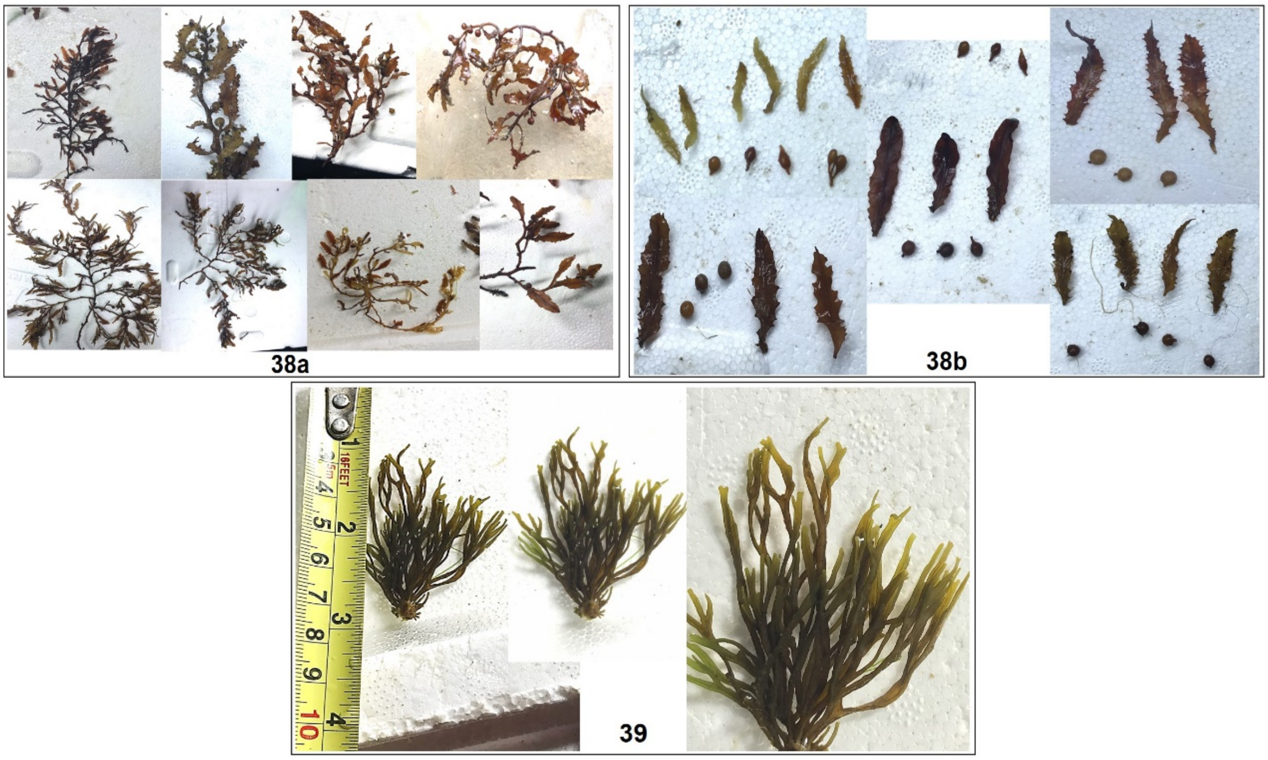

Figure 5. 1. *Cladophora* sp.; 2. *Cladophora glomerata*; 3. *Cladophora sericea*; 4a. *Chaetomorpha antennina*; 4b. *Chaetomorpha antennina* (with bleached edges) 5. *Ulva intestinalis*; 6. *Ulva flexuosa*; 7. *Bryopsis pennata*; 8. *Blidingia minima*; 9. *Gelidium pusillum*; 10. *Gelidiella sp.*; 11. *Vertebrata thuyoides*; 12 - 18. Rhodophyta (unspecified); 19. *Caloglossa leprieurii*; 20. *Centroceras clavulatum*; 21. *Ceratodictyon variabile*; 22. *Laurencia sp.*; 23. *Chondria sp.*; 24. *Chondrus ocellatus*; 25 - 28. *Gracilaria sp.*; 29. *Gracilaria corticata*; 30 - 34. *Grateloupia sp.*; 35. *Grateloupia lithophila*; 36. *Grateloupia filicina*; 37. *Caulacanthus ustulatus*; 38a. *Sargassum sp.* (thallus); 38b. *Sargassum sp.* (leaves and vesicles); 39. *Chnoospora minima.*

Table 2. Summary of seaweed species found at the sampled stations.

S/N	Phylum (Group)	Class	Family	Species
1	Chlorophyta (Green Algae)	Ulvophyceae	Cladophoraceae	*Cladophora* sp.
2		Ulvophyceae	Cladophoraceae	*Cladophora glomerata*
3		Ulvophyceae	Cladophoraceae	*Cladophora sericea*
4		Ulvophyceae	Cladophoraceae	*Chaetomorpha antennina*
5		Ulvophyceae	Ulvaceae	*Ulva intestinalis*
6		Ulvophyceae	Ulvaceae	*Ulva flexuosa*
7		Ulvophyceae	Bryopsidaceae	*Bryopsis pennata*
8		Ulvophyceae	Kornmanniaceae	*Blidingia minima*
9	Rhodophyta (Red Algae)	Florideophyceae	Gelidiaceae	*Gelidium pusillum*
10		Florideophyceae	Gelidiellaceae	*Gelidiella* sp.
11		Florideophyceae	Rhodomelaceae	*Vertebrata thuyoides*
12		Florideophyceae	*na*	*na*
13		Florideophyceae	*na*	*na*

Continued

14		Florideophyceae	*na*	*na*
15		Florideophyceae	*na*	*na*
16		Florideophyceae	*na*	*na*
17		Florideophyceae	*na*	*na*
18		Florideophyceae	*na*	*na*
19		Florideophyceae	Delesseriaceae	*Caloglossa leprieurii*
20		Florideophyceae	Ceramiaceae	*Centroceras clavulatum*
21		Florideophyceae	Lomentariaceae	*Ceratodictyon variabile*
22		Florideophyceae	Rhodomelaceae	*Laurencia* sp.
23		Florideophyceae	Rhodomelaceae	*Chondria* sp.
24		Florideophyceae	Gigartinaceae	*Chondrus ocellatus*
25		Florideophyceae	Gracilariaceae	*Gracilaria* sp.
26		Florideophyceae	*na*	*na*
27		Florideophyceae	*na*	*na*
28		Florideophyceae	*na*	*na*
29		Florideophyceae	Gracilariaceae	*Gracilaria corticata*
30		Florideophyceae	Halymeniaceae	*Grateloupia* sp.
31		Florideophyceae	*na*	*na*
32		Florideophyceae	*na*	*na*
33		Florideophyceae	*na*	*na*
34		Florideophyceae	*na*	*na*
35		Florideophyceae	Halymeniaceae	*Grateloupia lithophila*
36		Florideophyceae	Halymeniaceae	*Grateloupia filicina*
37		Florideophyceae	Caulacanthaceae	*Caulacanthus ustulatus*
38	**Heterokontophyta (Brown Algae)**	Phaeophyceae	Sargassaceae	*Sargassum* sp.
39		Phaeophyceae	Scytosiphonaceae	*Chnoospora minima*

**na*: unidentified taxa.

3.4. Seaweed Abundance and Biodiversity

The percentage of species abundance was 100% of just Sargassum in stations 1 and 2, reflecting a lack of biodiversity. However, station 3 and station 4 had high species abundance and biodiversity (**Figure 6**).

The most dominant phylum with the highest abundance was Rhodophyta (Red macroalgae), with 29 species representing 74% of the total seaweed species found (**Figure 7**). This was followed by Chlorophyta (Green macroalgae) with 8 species making up 21% of the total species abundance. Heterokontophyta (Brown macroalgae) which was represented by 2 species contributing 5% of the total

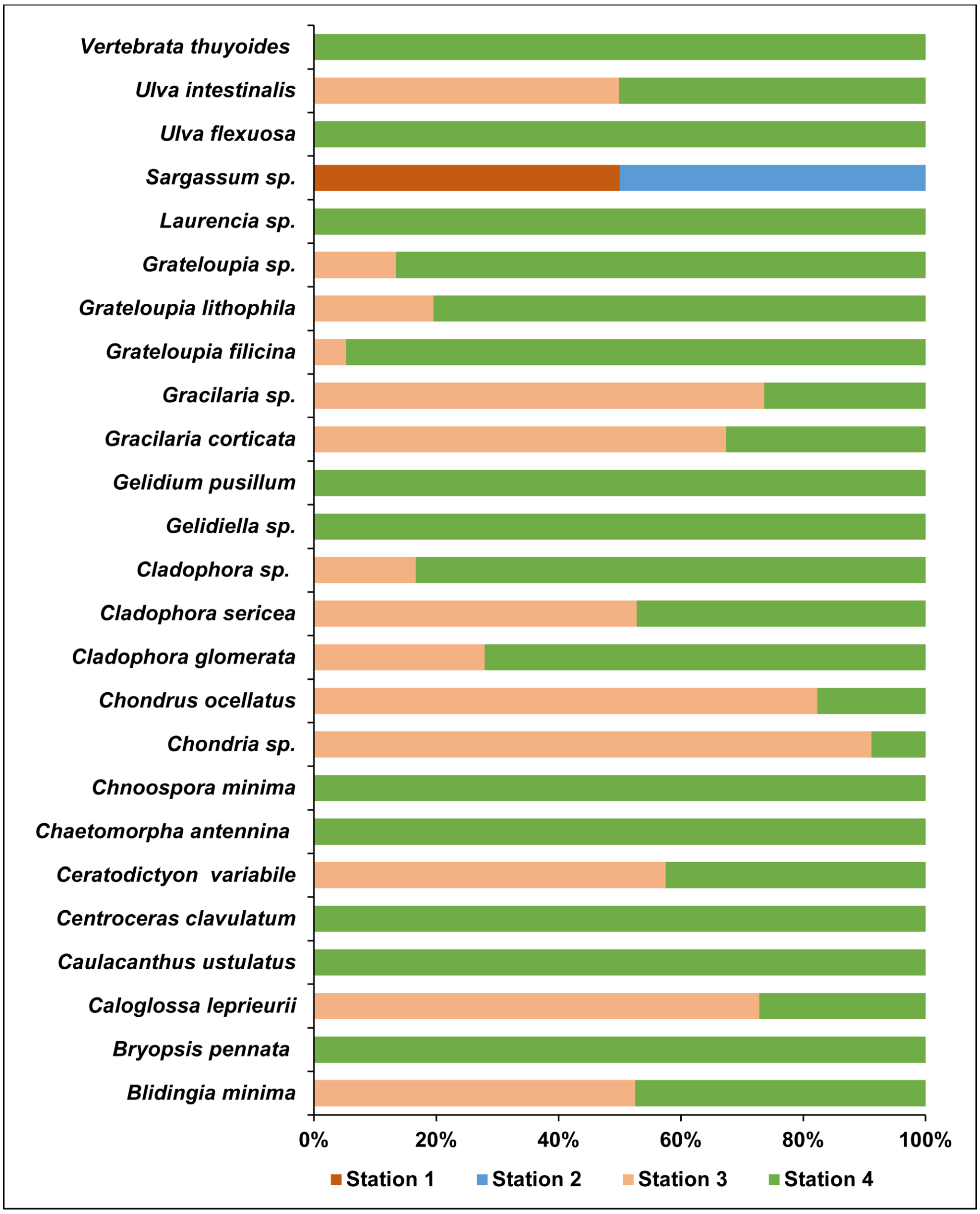

Figure 6. Percentage of species abundance and Biodiversity across the four (4) stations.

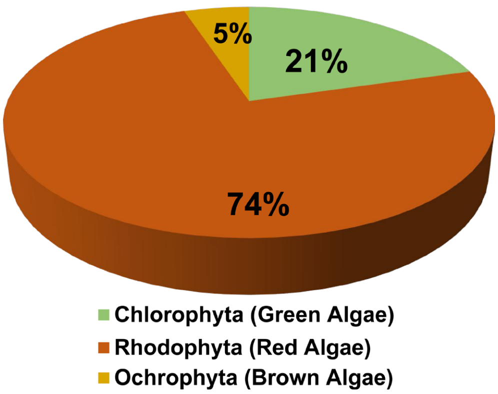

Figure 7. Percentage of species abundance at the phylum level.

species abundance (**Figure 7**). The Cladophoraceae families from the green algae were the most represented with 16% of the families represented followed by those of the Rhodomelaceae and Halymeniaceae from the red algae with 12% each. The Ulvaceae (green algae) and Gracilariaceae (red algae) families represented 8% each. Lastly, the *Bryopsidaceae*, *Kornmanniaceae*, *Gelidiaceae*, *Gelidiellaceae*, *Rhodomelaceae*, *Delesseriaceae*, *Ceramiaceae*, *Lomentariaceae Gigartinaceae*, *Gracilariaceae*, *Halymeniaceae*, *Caulacanthaceae*, *Sargassaceae*, and *Scytosiphonaceae* families were the least represented with 4% each (**Figure 8**).

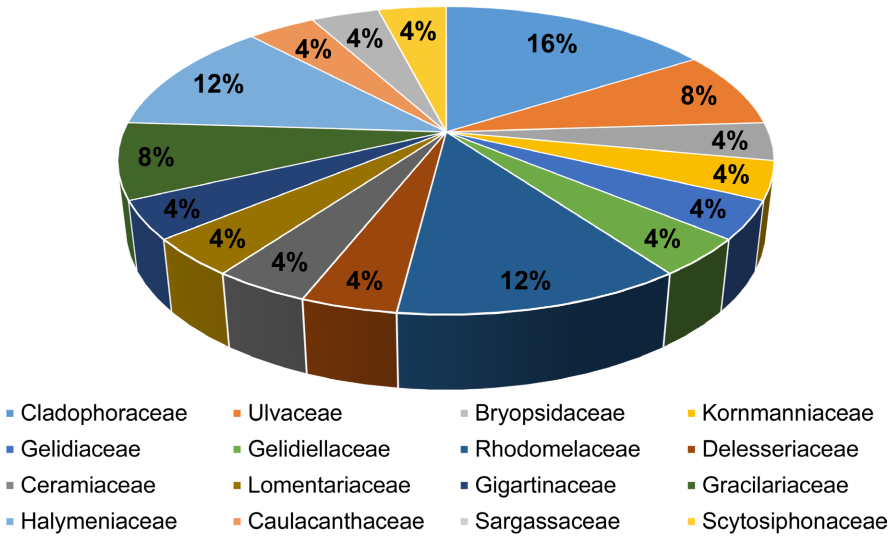

Figure 8. Percentage of species abundance at the family level.

4. Discussion

Studies on seaweeds in Nigeria remain limited, despite the rich diversity, ecological importance, and economic potential of these species. Fakoya *et al.*, reported a list of 79 seaweed species in Nigeria, consisting of 38 red, 24 green, and 17 brown seaweeds, which was sourced from https://www.algaebase.org/ [20]. This distribution aligns with the findings of the current study, where the proportion of red seaweeds was highest at 74%, followed by green seaweeds at 21%, and brown seaweeds at just 5%. However, their list lacks pictorial taxonomic identification of species and does not indicate their current availability. Given the absence of illustrated literature on seaweeds in Nigeria, this study aims to fill that gap by providing photographic evidence of some seaweed species found in Lagos, Nigeria.

Despite the advancements in marine biology, seaweed identification still presents significant challenges. Seaweeds are known for their phenotypic plasticity [21]-[23], exhibiting a wide range of forms, sizes and colours influenced by environmental conditions such as hydrodynamic forces, nutrient level, light intensity or growth level, largely interpreted as adaptive mechanisms [24]-[27]. This can make it difficult to distinguish between different species based on visual cues alone. Many seaweed species have similar appearances, making it challenging to differentiate them without specialized knowledge and tools. This is particularly true for certain groups, such as the red algae. Though molecular analysis is the definite tool or method for confirming the species of seaweed, while that may be cost intensive, we can rely to some extent on the morphological and ecological characteristics of the seaweed to infer the taxa or group they belong to. In this study, most of the identifying difficulties was with the coloration and branching patterns of the seaweed samples collected. Among the samples collected in this study, we found morphologically similar seaweeds but with different colourations. In addition, some of the seaweeds presumed to be of the same taxa were having differing forms. The variations in colour and possibly forms in this study could be attributed to environmental factors. Gouveia *et al.*, showed that exposure to heavy metals like Lead (Pb) and Copper (Cu) can alter the normal pattern of dichotomous branching by reducing the quantities of dichotomies and even causing extreme bleaching when exposed to Cu. Sunlight has been reported to cause bleaching in seaweed thallus, especially at the apical [28]. Sampath-Wiley *et al.*, demonstrated that photosynthetic pigments of seaweeds were majorly affected by sunlight exposure [29]. In this study, discoloration towards the apical end of the blade was observed in *Chaetomorpha antennina* (**Figure 5** (no. 4b)). Red algae exposed to strong sunlight can become greenish because of the dominance of chlorophyll, rather than purplish red as a result of the phycobilines [30], this was observed in the Grateloupia spp (**Figure 5** (no. 30-35)) in this study.

In this study, stations 1 (Jegeme beach) and 2 (Ibeshe beach) were mainly characterized by a sandy substrate, with no hard substrates or sunken vessels in these stations. There were human activities (tourism, and local community/fishermen activities) in both station 1 and 2. Station 3 (Anchorage) is within Lagos coastal water where vessels from and to international waters anchor temporarily for repairs, inspection, detention or arrest or for any other reasons, and the long-standing vessels become fouled by marine growth. Station 4 (Lighthouse beach/West Mole) is characterised by a sandy beach, intertidal riprap breakwater rocks, and sunken vessels exposed by low tide. Very low species abundance was observed in station 1 and 2. This could be attributed to the absence of appropriate substrates needed for attachment. However, stations 3 and 4 have a moderate number of species, with station 4 having the highest number of species. Sargassum was observed to be the dominant species in stations 1 and 2, with the high species diversity recorded in stations 3 and 4. However, station 3 had the most abundant seaweed species which includes *Cladophora sp.*, *Gracilaria sp.*, *Chondria sp.*, *Caloglossa leprieurii*, *Grateloupia sp.*, and *Gelidium pusillum*. In station 4, the seaweed species with the highest biomass were *Grateloupia sp.*, *Chaetomorpha antennina*, *Gracilaria sp.*, *Ceratodictyon variabile*, *Cladophora sp.*, *Gelidium pusillum*, *Ulva sp.*, *Blidingia minima*, and *Caloglossa leprieurii*. Seaweed biodiversity in station 4 differed from those in station 1, 2, and 3, this could be a result of the differences in the environmental conditions. The overall seaweed biodiversity in this study differed from those reported in other countries [31]-[35]. Differences in seaweed biodiversity obtained in this study when compared to other reports could be due to differences in the number of sampling locations, as well as differences in environmental parameters both in coastal topography, substrate, and transparency of waters, anthropogenic impacts and seasonal influences.

Since most benthic marine macroalgae are epilithic, their population abundance and biodiversity will be determined by the presence of natural or artificial hard benthic substrates in the spray zone, intertidal, or subtidal zone [36]. The level of seaweed diversity at anchorage (station 3) could be determined by the environmental conditions, the size and number of the substrates available for attachment (body of vessels) and the duration of the vessels in the marine environment before vessel defouling. In addition, the point of origin of the vessels at anchorage plays a role in the diversity of seaweeds. A significant portion of the seaweed species present may be non-native, possibly originating from Asia. Initial taxonomic analysis of the seaweed samples showed a strong similarity to known species commonly found in Asian waters. This includes genera such as Sargassum, Gracilaria, and Grateloupia, which are mostly native to Asian marine ecosystems, particularly in regions such as Southeast Asia and the Western Pacific [37]-[39]. These species are likely being introduced through international shipping activities, specifically via vessels arriving from Asian regions. The mechanism of introduction is most likely the attachment of seaweed to ship hulls or dispersed via ballast water discharge, both of which are well-documented pathways for the spread of marine organisms across regions [40] [41].

Lagos State is a major port in Nigeria, with high levels of maritime traffic. Many of the ships arriving in Lagos are engaged in international trade routes, including significant traffic from Asian countries. Shipping vessels are a known vector for the transportation of marine organisms through ballast water discharge or hull fouling [40] [41]. Seaweed spores or fragments can attach to the hulls of ships or be released into local waters when ballast water is discharged. Given the frequency of maritime exchanges between Lagos and Asia, it is plausible that most of the seaweed found may be non-native seaweeds introduced through these means. Studies from other global ports have demonstrated similar cases where invasive seaweed species have been transported across oceans attached to vessels. Many invasive species that are found in other parts of the world, such as Europe and North America, have been traced back to Asian waters. [42]-[46]. The high frequency of shipping between Lagos and Asia makes this a likely pathway for the observed seaweed species. Although, there are no sufficient historical records and ecological surveys of Nigerian coastal waters that will indicate whether the seaweeds found in this study were all or partly native or non-native species.

Seaweeds play a significant role both ecologically and economically in coastal ecosystems, including those in Nigeria. Seaweeds contribute to biodiversity by providing habitat, food, and nursery grounds for various marine organisms, including fish, invertebrates, and microorganisms [47]. Their presence enhances coastal water quality by absorbing excess nutrients which helps regulate algal blooms and mitigate coastal eutrophication [48]. Additionally, seaweeds contribute to carbon sequestration, playing a role in climate change mitigation by absorbing and storing atmospheric carbon dioxide [49]. In many parts of the world, seaweeds are harvested for various commercial applications, including the production of food, cosmetics, pharmaceuticals, and biofuels [12]. In Nigeria, the economic potential of seaweed remains largely untapped, but there are growing opportunities for seaweed cultivation, especially for the production of agar, alginate, and carrageenan, which are widely used as gelling agents in the food and cosmetic industries [50]. Moreover, seaweeds have emerging applications in biotechnology, particularly in bioremediation and as a source of bioactive compounds with medicinal properties [51]. Given the rich diversity of seaweeds along the Nigerian coastline, as demonstrated in this study, promoting sustainable seaweed harvesting and cultivation could contribute to local economies and create job opportunities in coastal communities. At the same time, conserving seaweed populations is crucial for maintaining the ecological balance of coastal ecosystems and ensuring the continued provision of the vital ecosystem services they offer [52]. Economically important species such as *Cladophora* sp., *C. glomerata*, *C. sericea*, *Chaetomorpha antennina*, *Ulva intestinalis*, *U. flexuosa*, *Bryopsis pennata*, *Gelidium pusillum*, *Caloglossa leprieurii*, *Laurencia* sp., *Chondria* sp., *Chondrus ocellatus*, *Gracilaria* sp., *G. corticata*, *Grateloupia* sp., *Grateloupia lithophila*, *G. filicina*, *Sargassum* sp. were found in this study and some are yet to be explored for their economic and ecological importance.

5. Conclusion and Recommendation

This study has provided the first comprehensive assessment of seaweed diversity along the Lagos coastal waters, identifying 39 seaweed species, with a dominance of red algae (74%). The findings underscore the potential of seaweeds in Nigeria to contribute to sustainable industries such as aquaculture and climate change mitigation through carbon sequestration. The variation in seaweed distribution, with higher diversity observed at rocky coastal sites, highlights the importance of habitat type in supporting seaweed biodiversity. This research serves as a foundational step toward understanding Nigeria's marine biodiversity, which is critical for the development of conservation strategies and sustainable exploitation.

Future studies could focus on the molecular characterization of the identified species to confirm their taxonomy and explore genetic diversity. This would aid in distinguishing between native and non-native species, especially given the possibility of species introductions through international maritime traffic. Larger and more systematic sampling across broader geographic and temporal ranges will provide a more comprehensive understanding of seaweed species composition and their ecological roles in Nigeria. This is essential for accurate species inventories and assessments of their commercial potential. Given the significant commercial potential of species like *Sargassum*, *Gracilaria*, and *Ulva*, promoting sustainable seaweed cultivation could contribute to Nigeria's blue economy. This would not only generate employment opportunities in coastal communities but also support global climate change mitigation efforts.

Acknowledgments

We extend our sincere gratitude to the staff of Nigerian Institute for Oceanography and Marine Research (NIOMR), Mrs. Hogan Iheoma Gloria, Dr Ayaobu-Cookey Kalada Ibifubara, Mr. Peter Solomon Olawale, Dr. Benjamin Ifenachor Ebonwu, Dr. Ikoyo Eweto Gloria, and other staff for their technical support. We appreciate Mr Dele Alex-Duduyemi for his invaluable assistance, Captain MK for his assistance and the team from AquaEarth Consulting for their assistance in the fieldwork. We also acknowledge the invaluable contributions of local fishermen and divers from the Jegeme and Ibeshe communities, whose expertise and cooperation were essential to the success of this study. Finally we appreciate sincerely all the reviewers for their comments and suggestions to improve the quality of the manuscript.

Author Contributions

E.U.K: study conception and design, study execution, data collection, curation and analysis, writing the manuscript. D.O.B: study execution, data collection, curation and analysis. D.A.B.: study planning, data processing. A.O.: data collection. S.E.: data collection. E.K.A.: study design and data collection. O.A.: study conception All authors read and approved the final manuscript.

Funding

This study was funded by Africa Seaweed Ventures (ASV), London, United Kingdom.

Data Availability

The datasets generated during and/or analysed during the current study are available in this report, any other data required will be available from the corresponding author on reasonable request.

Declarations

Ethics

In this study no experiments with animals or humans were performed.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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